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SOLID WASTE MANAGEMENT - A REVIEW

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Abstract— With the increase in population, the management of municipal solid waste in India emerged as a severe problem not only because of the environmental and aesthetic concerns but also because of the total quantities of solid waste generated every day. The study was undertaken to study the existing system of collection, storage, transportation and disposal of MSW in Narhe, which is significantly progressing and growing village in population on the peripheral part of Pune. This study was carried out to access the quantity and quality of MSW. The study indicates that the solid waste management system is not proper. The present system is focused on collection and transportation of largely mixed unsegregated waste. The segregated collection of solid waste is needed to be planned. Awareness related to home composting should be spread across the community. The facility for composting and material recovery can be provided. The waste which does not undergo any physical, chemical or biological transformation which is inert in nature can be used as landfilling material.

Keywords - Solid Waste, Environmental Sustainability, Infrastructure Development, Awareness, existing system.

I. INTRODUCTION

Solid waste management is the organized and systematic handling of waste materials, from their generation to their final disposal, with the goal of minimizing negative environmental and health impacts. It involves a range of activities, including waste collection, transportation, processing, recycling, and disposal. Solid waste can include various types of materials, such as household trash, industrial waste, construction debris, and hazardous substances. The importance of solid waste management has grown alongside urbanization and industrialization, which have significantly increased the volume and complexity of waste produced by human activities. Poorly managed waste can lead to pollution, environmental degradation, and public health

problems. As a result, effective solid waste management is essential for protecting ecosystems, ensuring public health, and promoting sustainable development.

Solid waste management (SWM) in India has been a growing challenge due to rapid urbanization, industrialization, and population growth. The country generates over 62 million tons of waste annually, with urban areas being the primary contributors. However, waste management practices have traditionally been inadequate, leading to environmental degradation, public health concerns, and challenges in waste disposal.

Current Practices of Solid Waste Management in India

Solid waste management in India is a growing challenge due to rapid urbanization, population growth, and increasing consumption patterns. The country generates millions of tons of solid waste annually, with major cities being the biggest contributors. The solid waste management system in India is evolving, but there are significant issues related to infrastructure, awareness, and enforcement

Key Issues in Solid Waste Management in India:

1. High Waste Generation
2. Unsegregated Waste
3. Informal Sector Involvement
4. Open Dumping and Unscientific Landfills
5. Low Recycling Rates

Government Initiatives and Regulations

- **Municipal Solid Waste (Management and Handling) Rules, 2000:** This was India's first comprehensive law addressing SWM, requiring local authorities to establish waste collection, segregation, recycling, and disposal systems. However, its implementation has been slow and inconsistent across states.
- **Solid Waste Management Rules, 2016:** These rules updated the 2000 regulations and focused on source segregation of waste, promoting composting, and

encouraging waste-to-energy technologies. They also mandated that bulk waste generators (institutions, hotels, and housing societies) handle their own waste.

- **Swachh Bharat Mission (Clean India Mission):** Launched in 2014, this nationwide campaign focuses on improving sanitation and cleanliness in urban and rural areas, including waste management. The mission promotes waste segregation, door-to-door collection, and scientific processing of waste. Cities are ranked under the Swachh Survekshan (Cleanliness Survey), which encourages local governments to improve SWM practices.
- **Extended Producer Responsibility (EPR):** EPR is increasingly being applied in India, especially for plastic and e-waste. Manufacturers are responsible for the lifecycle of their products, ensuring that proper recycling and disposal mechanisms are in place.

Current Practices of Solid Waste Management in Maharashtra

Maharashtra, as one of India's most populous and industrialized states, faces significant challenges in solid waste management (SWM). The state's urban centers, particularly Mumbai, Pune, and Nagpur, generate vast amounts of waste daily, requiring well-structured waste management systems. Over the years, Maharashtra has made notable progress in addressing these challenges through innovative practices, regulatory frameworks, and public awareness campaigns.

Key Issues in Solid Waste Management in Maharashtra

1. Ineffective Waste Segregation
2. Overburdened Landfills
3. Inadequate Waste Treatment Infrastructure
4. Involvement of Informal Sector
5. Waste Transportation Issues
6. Public Awareness and Participation
7. Regulatory and Enforcement Challenges

Government Initiatives and Regulations

- **Pune's Decentralized Waste Management:** Pune has been one of the most progressive cities in Maharashtra in terms of SWM, largely due to the involvement of waste pickers and informal sector workers. The Pune Municipal Corporation has partnered with the SWaCH Cooperative, a worker-owned cooperative of waste pickers, to manage door-to-door collection and waste segregation. This decentralized model has helped the city achieve higher waste recovery rates, particularly in recycling.
- **Zero Waste Initiatives:** Several municipalities and residential communities across Maharashtra have adopted zero-waste initiatives. In Thane and Navi Mumbai, zero-waste housing societies have been established, where residents are encouraged to compost organic waste and

recycle dry waste, reducing the overall waste sent to landfills.

- **Swachh Bharat Mission and Swachh Survekshan:** Maharashtra's urban centers have actively participated in the Swachh Bharat Mission (Clean India Mission), leading to cleaner public spaces, enhanced waste collection systems, and better awareness among citizens. Cities like Navi Mumbai and Pune have consistently ranked high in the Swachh Survekshan cleanliness rankings, reflecting the success of their SWM initiatives.

Problem Statement

Maintaining environmental sustainability, urban livability, and public health all depend on efficient solid waste management. Nonetheless, a lot of rural and urban communities struggle to manage the growing amounts of solid garbage produced by their inhabitants. These difficulties include low recycling rates, poor waste segregation at the source, inadequate infrastructure for waste collection and disposal, and low public knowledge and engagement.

Poor waste management techniques have a number of detrimental effects, including resource recovery that is inefficient, pollution of the environment, and health risks from inappropriate disposal. More specifically, issues like open dumping, overflowing landfills, and contaminated soil and water supplies are common.

Comprehensive and integrated SWM plans that include efficient waste segregation, collection, recycling, and disposal techniques are required to address these problems. This entails raising public awareness and educating the public, upgrading technology and infrastructure, and putting laws in place that encourage environmentally friendly garbage disposal methods.

Objectives

- To study the existing system of collection, storage, transportation and disposal of solid waste.
- To assess the quantity of waste generated in Narhe.
- To study physical properties of solid waste.
- To suggest the suitable method for disposal of waste.

II. LITERATURE REVIEW

1. **Prakash Awasthi et al (2023)** The creation of garbage has increased as a result of the growing global population and rising consumer demand. Waste management is much more complicated. In the Kirtipur municipality's Kirtipur-10, a study was carried out to determine the makeup of home solid waste and to identify potential remedies. In November 2022, focus groups and household surveys were conducted as part of the study
2. **Dheeraj Gour, et al (2022)** A clean environment is essential, therefore India's Prime Minister, Shri Narendra Modi, announced the Swachh Bharat Mission to offer basic amenities like safe water supply, sanitation, hygiene, and appropriate waste disposal at the community



level. This study evaluates household solid waste collection and disposal habits and knowledge in Jajankhedi Village, a rural Madhya Pradesh village in the Sehore District.

3. **Rasmeet Singh et al (2021)** The management of municipal solid waste is essential since metropolitan areas are seeing fast population expansion. The intricacy of trash generation and high generation rates present issues for Municipal Corporation Indore. It is imperative to give municipal solid waste management and infrastructure development first priority because the city is home to over 19 lakh people.
4. **Harit Priyadarshi, et.al (2020)** This study looks at waste in Aligarh, Uttar Pradesh, India, including its features, methods, impacts on the environment, health risks, and insufficient waste management strategies. It shows that open dump sites that catch fire, a large amount of trash, insufficient capacity for collection, a delay in the approval of new landfill sites, and a lack of care are the main reasons why the current facilities are failing.
5. **S. Anwar et al (2018)** The ideal arrangement of municipal solid waste (MSW) management systems is the main topic of the study, which takes into account decentralized, clustered, and centralized systems. It lists technologies such as composting, landfilling, waste-derived fuel, recycling, and reuse. A centralized system for trash collection and treatment and a clustering system for waste treatment centers are part of the cost optimization model, which also takes location planning into account.
6. **Sudarshan Kumar et.al (2016)** The Department of Civil Engineering at Poornima Group of Institutions conducted a comprehensive study on solid waste management in Jaipur city. The study revealed that there is no proper mechanism in place for treating waste, leading to waste dumping in open areas, posing significant environmental and human health hazards. The findings highlight the need for improved waste management practices in Jaipur to address this global issue.
7. **Naveen BP et.al (2016)** Bengaluru, India's fast urban population and economic expansion have generated a large volume of municipal solid garbage, which presents major issues for companies and municipalities. The 2000 municipal solid waste regulations are not followed by the waste management system now in place, which is run by Bruhan Bengaluru Mahanagar Palika. About 5000 tons of rubbish are produced, of which 30% are picked up by the BBMP and 70% are moved by contractors. Because there isn't a sanitary landfill that is operating correctly and the mix of garbage is changing, there are health hazards and soil, ground water, and air contamination.
8. **Subhash Rane Observer Research Foundation Mumbai et.al (2015)** The 74th Constitutional Amendment requires the Mumbai Metropolitan Region, which consists of seven municipal corporations, to

manage solid waste within their respective functional domains. These companies currently use centralized waste management techniques, and after collection, the material is disposed of in approved landfills. On the other hand, newcomers to the recycling industry and the unorganized sector are also contributing significantly to waste management by creating decentralized waste management procedures.

9. **Rishi Rana et.al (2014)** Rapid population expansion, urbanization, and industrialization have made solid waste management a major challenge in both developed and developing nations. Because of this, a variety of wastes have been produced, which calls for efficient management in order to promote sustainable development. Forecasting and quantity estimation are essential for effective management plans. Since poor management can result in health and environmental concerns, there needs to be more focus on acceptable systems for handling huge amounts of municipal solid garbage in major cities due to the rising volume of waste generated in these areas.
10. **Anurag Tiwari Mishra et al (2014)** The study on solid waste management techniques carried out by Yavatmal Municipal Corporation is discussed in the article. It focuses on the waste composition in the city and emphasizes the significance of managing trash generation, storage, collection, transfer, processing, and disposal.

III. METHODOLOGY

Phase of the methodology

- Problem Identification
- Waste Characterization
- Stakeholder Analysis
- Assessment of Existing Systems
- Infrastructure & Resource Assessment
- Gap Analysis
- Public Participation
- Development of Solutions
- Feasibility Analysis
- Implementation Plan
- Monitoring & Evaluation
- Reporting

Table No. 01 Phase of the methodology

Steps	Objective	Method/Tools Used	Expected Outcome
1. Problem Identification	Identify solid waste management issues	Field surveys, interviews, data collection	Clear understanding of waste types and volumes
2. Waste Characterization	Classify types of waste (organic, plastic, etc.)	Physical sampling, laboratory analysis	Categorized waste (organic, inorganic, hazardous, etc.)
3. Stakeholder Analysis	Identify key stakeholders (e.g., municipality, residents)	Surveys, meetings, workshops	List of key stakeholders and their roles
4. Assessment of Existing Systems	Review current waste management practices	Review of reports, observation, system audits	Evaluation of the efficiency of current systems
5. Infrastructure & Resource Assessment	Evaluate available infrastructure (collection, treatment, disposal)	Site visits, infrastructure inventory	Assessment of gaps in infrastructure
6. Gap Analysis	Identify gaps in the existing waste management system	Comparison between current state and best practices	Defined areas for improvement in management and systems
7. Public Participation	Engage the community in waste management efforts	Public awareness campaigns, focus groups	Improved community awareness and participation
8. Development of Solutions	Formulate sustainable waste management strategies	Technical workshops, expert consultations, modeling tools	Practical and sustainable waste management solutions
9. Feasibility Analysis	Assess the feasibility of proposed solutions	Cost-benefit analysis, environmental impact assessment	Viable solutions for waste management improvements
10. Implementation Plan	Develop a roadmap for implementing solutions	Project timelines, action plans, allocation of resources	Detailed implementation plan with roles and responsibilities
11. Monitoring & Evaluation	Track progress and effectiveness of implemented solutions	Performance indicators, regular audits, feedback	Continuous improvement of waste management practices
12. Reporting	Document findings, solutions, and progress	Report writing, presentations, publications	Comprehensive reports for stakeholders and authorities

IV. STUDY AREA & DATA COLLECTION

General

Narhe Village, is a rapidly growing suburban area located in the southwestern part of Pune, Maharashtra. Once a small village, it has experienced significant urbanization due to its proximity to Pune city and its integration into the larger metropolitan region. This growth has led to a rise in population, infrastructure development, and various residential and commercial projects. However, this urban expansion has also brought challenges, particularly in terms of managing the solid waste generated by the area. In recent estimates, Narhe's population is near about 50,000 people, though this figure is subject to change as urbanization continues. This population includes both permanent residents and a transient population of students, workers, and migrants.

The following are the longitude, latitude & elevation:

- Latitude : 18.446473°
- Longitude : 73.837954°

c) Elevation: 629 m

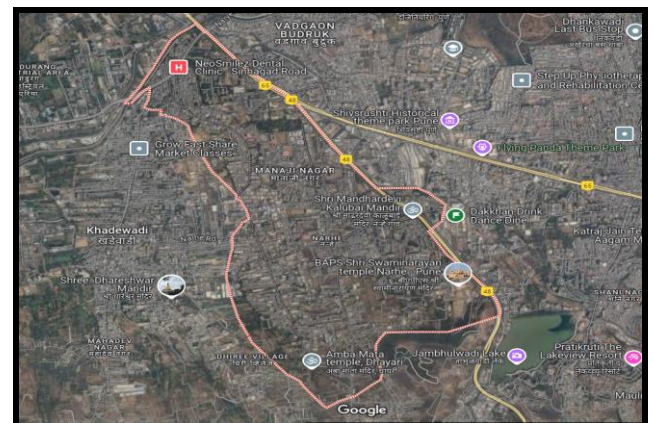


Fig. 01 – Location Map

Existing Status of Solid Waste Management

- Waste generation** - Narhe produces a wide variety of waste, including as building debris, commercial waste,

and residential refuse. garbage that is not biodegradable, such as plastics, paper, and other materials, is largely composed of organic garbage.

Source	Typical waste generators	Solid waste contents
Residential	Single and multifamily dwellings	Food wastes, paper, cardboard, plastics, textiles, leather, yard wastes, wood, glass, metals, ashes, special wastes (e.g., bulky items, consumer electronics, batteries, oil, tires), and household hazardous wastes.
Commercial	Stores, hotels, restaurants, markets, office buildings,	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes
Institutional	Schools, hospitals, government centres	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes.
Construction and demolition	New construction sites, road repair, renovation sites, demolition of buildings	Wood, steel, concrete, dirt, etc.
Municipal services	Street cleaning, landscaping, parks, beaches, other recreational areas, water and wastewater treatment plants.	Street sweepings; drain silt; landscape and tree trimmings; general wastes from parks, beaches, and other recreational areas; sludge.

Table.2 Sources of Waste

- Collection System** - With a village in Narhe producing 25 tons of rubbish a day, the Pune Municipal Corporation (PMC) has struggled to keep up with the village's expanding waste collection needs. The PMC has experienced staffing shortages and inefficiencies, which has left locals feeling that the services provided were better under the previous Gram Panchayat system. The villagers had to pool their money to hire waste pickers and rent garbage collection trucks. There has been a slow pace of improvement efforts, and environmental issues like insects and stray animals still plague the area.
- Transportation** - Compactor trucks are used to transport the collected rubbish to a disposal facility close by. Inadequate transportation and infrastructure frequently cause bottlenecks and inefficiency.
- Disposal and Processing** - Much like waste collection, solid waste disposal and processing in Narhe village are fraught with difficulties. Since the village is now a part of the Pune Municipal Corporation (PMC), PMC's solid waste management facilities will be responsible for processing the waste produced. However, a sizable amount of the waste is either not collected at all or is disposed of incorrectly because of staffing shortages and logistical problems.

Table 3 Quantity of Waste Generated in Narhe

Parameter	Description
Total population	50,000
Waste generation rate	25 tons / day
Recycled waste	10 tons / day
Rejected projects	5 tons / day
Plastic/loose plastic	5 tons / day
Papers	2.5 tons / day
Glass	1 tons / day
Steel	0.5 tons / day
Other	1 tons / day
Transportation method	Compactor trucks
Treatment facilities	Composting

Challenges

- Lack of awareness:** Many residents may not be aware of the importance of waste segregation, or they lack the facilities to
- Operational inefficiencies:** Due to budget constraints, there may be inefficiencies in the daily collection and transportation of waste, leading to delays and higher costs.



- **Outdated technologies:** The technology used for waste collection, treatment, and disposal is often outdated. Manual collection methods, inefficient recycling, and reliance on landfills are still common.
- **Lack of proper waste treatment plant:** There may be an absence of advanced waste treatment facilities like composting plants, recycling centers, and waste-to-energy plants.
- **Air and water pollution:** Poor waste management leads to environmental hazards like air pollution from burning waste, leachate from landfills contaminating groundwater, and foul odors affecting nearby areas.
- **Impact on public health:** Inadequate disposal and accumulation of waste contribute to the spread of diseases, attract pests, and degrade the quality of life in surrounding areas.
- **Informal waste sector:** The informal sector, such as waste pickers, often plays a significant role in recycling but operates in poor conditions without proper support.
- **Low recycling rates:** Village like Narhe may face challenges in achieving high recycling rates due to inadequate infrastructure, low public awareness, and the lack of a formalized recycling system.

V. RECOMMENDATIONS

1. The study suggests a comprehensive strategy for managing waste, with a particular emphasis on the creation of decentralized waste processing centers, stringent regulations for waste segregation, rewards for consistent waste segregation, increased frequency and coverage of waste collection services, and proper maintenance of waste collection vehicles.
2. Additionally, it promotes community composting and awareness campaigns to inform people about the negative effects incorrect waste disposal has on the environment and human health.
3. The "pay-as-you-throw" business model, public involvement in garbage management initiatives, and sustainable habits are all encouraged by the scheme.
4. Additionally, it recommends low-interest loans or subsidies for small business owners operating recycling and trash processing operations.

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